

5.0 EXPOSURE QUANTIFICATION

This section discusses how the exposures evaluated in the HHRA will be quantified under each of the exposure scenarios. As with the media concentrations, the IRAP-*h* VIEW[®] software (Lakes 1999) will execute all of the exposure quantification calculations. To calculate the COPC-specific intakes for each exposure pathway, the following variables are necessary: (1) the estimated COPC media concentration, (2) the consumption rate, (3) the receptor body weight, and (4) the frequency and duration of exposure. The exposure factors for calculating COPC exposure rates are presented in Table 5-1. Sections 5.1 through 5.6 discuss the intake equations and calculations for the exposure pathways to be evaluated in the HHRA.

The exposure quantification or intake equations are presented in Appendix F.

5.1 CALCULATING AIR CONCENTRATIONS FOR DIRECT INHALATION

Average daily intake via COPC inhalation is calculated using Equation F-2-1.

5.2 CALCULATING INTAKES FROM SURFACE SOIL

The intake from surface soil equation calculates the daily intake of COPCs from soil consumption (see Equation F-1-1). The soil concentration will vary with each scenario location, and the soil consumption rate varies for children and adults.

5.3 CALCULATING INTAKES FROM SURFACE WATER

The surface water intake equation calculates the daily intake of COPCs from drinking water (see Equation F-1-5). COPC intake from drinking water is calculated from the COPC concentration dissolved in the water column of each surface water body or watershed identified as a drinking water source (U.S. EPA 1998a). The dissolved concentration is used for calculating COPC intake from drinking water because it is assumed that the water is filtered prior to human consumption. The COPC concentration will vary for each water body, and the consumption rate is different for children and adults.

TABLE 5-1

EXPOSURE PARAMETERS FOR HEALTH RISK ASSESSMENT

Exposure Parameter	Resident		
	Adult	Child	Reference
Body Weight (kg)	70	15	U.S. EPA 1998a
Exposure Duration (yr)	30	6	U.S. EPA 1998a
Averaging Time (carcinogens) (yr)	70	70	U.S. EPA 1998a
Averaging Time (noncarcinogens) (yr)	30	6	U.S. EPA 1998a
Inhalation of Ambient Air			
Exposure Frequency (d/yr)	350	350	U.S. EPA 1988
Inhalation Rate (m³/hr)	0.63	0.30	U.S. EPA 1998a
Ingestion of Surface Soil			
Exposure Frequency (d/yr)	350	350	U.S. EPA 1988
Ingestion Rate (g/d)	0.1	0.2	U.S. EPA 1998a
Ingestion of Drinking Water from Soldier Creek			
Exposure Frequency (d/yr)	350	350	U.S. EPA 1988
Ingestion Rate (L/d)	1.4	0.67	U.S. EPA 1998a
Exposure Parameter	Subsistence Rancher		
	Adult	Child	Reference
Body Weight (kg)	70	15	U.S. EPA 1998a
Exposure Duration (yr)	40	6	U.S. EPA 1998a
Averaging Time (carcinogens) (yr)	70	70	U.S. EPA 1998a
Averaging Time (noncarcinogens) (yr)	40	6	U.S. EPA 1998a
Inhalation of Ambient Air			
Exposure Frequency (d/yr)	350	350	U.S. EPA 1988
Inhalation Rate (m³/hr)	0.63	0.30	U.S. EPA 1998a
Ingestion of Surface Soil			
Exposure Frequency (d/yr)	350	350	U.S. EPA 1998a
Ingestion Rate (g/d)	0.1	0.2	U.S. EPA 1998a
Ingestion of Drinking Water			
Exposure Frequency (d/yr)	350	350	U.S. EPA 1998a
Ingestion Rate (L/d)	1.4	0.67	U.S. EPA 1998a
Ingestion of Homegrown Produce			
Exposure Frequency (d/yr)	350	350	U.S. EPA 1998a
Ingestion Rate (kg/kg BW/d DW)			
Exposed Aboveground Produce	0.0003	0.00042	U.S. EPA 1998a
Protected Aboveground Produce	0.00057	0.00077	
Belowground Produce	0.00014	0.00022	
Ingestion of Homegrown Meat, Eggs, and Milk			
Exposure Frequency (d/yr)	350	350	U.S. EPA 1998a
Ingestion Rate of Beef (kg/kg BW/d)	0.00114	0.00051	U.S. EPA 1998a
Ingestion Rate of Cow’s Milk (kg/kg BW/d)	0.00842	0.01857	U.S. EPA 1998a

TABLE 5-1 (Continued)

EXPOSURE PARAMETERS FOR HEALTH RISK ASSESSMENT

Exposure Parameter	Subsistence Rancher (Continued)		
	Adult	Child	Reference
Ingestion of Homegrown Meat, Eggs, and Milk (con't)			
Ingestion Rate of Poultry (kg/kg BW/d)	0.00061	0.000425	U.S. EPA 1998a
Ingestion Rate of Eggs (kg/kg BW/d)	0.00062	0.000438	U.S. EPA 1998a
Ingestion Rate of Pork (kg/kg BW/d)	0.00053	0.000398	U.S. EPA 1998a
Ingestion Rate of Mutton (kg/kg BW/d)	To Be Determined		
Ingestion Rate of Goat's Milk (kg/kg BW/d)	To Be Determined		
Exposure Parameter	Recreationist		
	Adult	Child	Reference
Body Weight (kg)	70	15	U.S. EPA 1997
Exposure Duration (yr)	30	6	U.S. EPA 1998a
Averaging Time (carcinogens) (yr)	70	70	U.S. EPA 1998a
Averaging Time (noncarcinogens) (yr)	30	6	U.S. EPA 1998a
Surface Water (Incidental Ingestion)			
Exposure Frequency (d/yr)	7	7	U.S. EPA 1988
Ingestion Rate (L/d)	0.1	0.1	U.S. EPA 1997
Ingestion of Fish			
Exposure Frequency (d/yr)	350	350	U.S. EPA 1998a (recommended for subsistence fisher scenario)
Ingestion Rate (kg/d)	1.17	0.759	U.S. EPA 1998a (recommended for subsistence fisher scenario)
Exposure Parameter	On-Site Depot Worker		
	Adult	Reference	
Body Weight (kg)	70	U.S. EPA 1997	
Exposure Duration (yr)	30	U.S. EPA 1998a (recommended for adult scenarios)	
Exposure Time (hr/d)	8	U.S. EPA 1991	
Averaging Time (carcinogens) (yr)	70	U.S. EPA 1998a (recommended for adult scenarios)	
Averaging Time (noncarcinogens) (yr)	30	U.S. EPA 1998a (recommended for adult scenarios)	
Inhalation of Ambient Air			
Exposure Frequency (d/yr)	250	U.S. EPA 1991	
Inhalation Rate (m ³ /hr)	0.63	U.S. EPA 1998a (recommended for adult scenarios)	
Ingestion of Soil			
Exposure Frequency (d/yr)	250	U.S. EPA 1991	
Ingestion Rate (g/d)	0.05	U.S. EPA 1991	

TABLE 5-1 (Continued)

EXPOSURE PARAMETERS FOR HEALTH RISK ASSESSMENT

Notes:

BW	Body weight
d/yr	Day per year
DW	Dry weight
FW	Fresh (wet) weight
g	Gram
g/d	Gram per day
hr/d	Hour per day
kg	Kilogram
kg/kg BW/d	Kilogram food FW/kilogram BW/day)
L/d	Liter per day
mg/day	Milligram per day
mL/hr	Milliliter per hour
m ³ /hr	Cubic meter per hour
U.S. EPA	U.S. Environmental Protection Agency
yr	Year

References:

- U.S. EPA. 1988. *Superfund Exposure Assessment Manual*. Office of Emergency and Remedial Response. EPA/540/1-88/001.
- U.S. EPA. 1991. "Memorandum Regarding the Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors." From Timothy Field, Jr. Acting Director, Office of Solid Waste and Emergency Response. To Distribution. March 25.
- U.S. EPA. 1997. *Exposure Factors Handbook*. Office of Health and Environmental Assessment. EPA/600/P-95/002Fa. August.
- U.S. EPA. 1998a. *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities*. Peer Review Draft. Office of Solid Waste. EPA-530/D-98-001A.
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5.4 CALCULATING INTAKES FROM HOMEGROWN PRODUCE

The intake equation for homegrown produce calculates the daily intake of COPCs from the ingestion of aboveground and belowground produce (see Equation F-1-2). The consumption rate varies for children and adults and by type of produce (U.S. EPA 1998a). The concentration in homegrown produce varies with each scenario location.

5.5 CALCULATING INTAKES FROM MEAT, MILK, AND EGGS

The intake equation for meat, milk, and eggs calculates the COPC intake from the ingestion of animal tissue and milk (see Equation F-1-3). The consumption rates vary for children and adults and by the type of animal tissue ingested (U.S. EPA 1998a). The concentration in animal tissue and milk will vary with each scenario location. The consumption rates were derived based on body weight; therefore, body weight is not included as a parameter in the intake equation (U.S. EPA 1998a).

5.6 CALCULATING INTAKES FROM FISH

The intake equation for fish calculates the daily intake of COPCs from the ingestion of fish (see Equation F-1-4). The consumption rates were derived from the *Exposure Factors Handbook* (U.S. EPA 1997). The consumption rates are based on body weight; therefore, body weight is not included as a parameter in the intake equation (U.S. EPA 1998a).